QA: QA

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Q-List

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CHANGE HISTORY

Revision Number	Interim Change No.	Effective Date	Description of Change
00	N/A	~~TBD~~ NA NP 10-1-03 Heather Patterell	Initial issue. This initial issue supercedes YMP/90-55Q Rev. 07 to conform with AP-2.22Q and AP-3.11Q. This initial issue classifies the preliminary License Application design structures, systems, and components; combines the separate appendices for classification of repository structures, systems, and components, Exploratory Study Facilities Engineered Items, and Natural Barriers that were a part of the superceded Q-List into one list of structures, systems, and components and barriers important to safety or important to waste isolation. The Exploratory Study Facilities Engineered Items were included in the repository structures, systems, and components.

The change history for YMP/90-55Q Rev. 07 follows as:

Revision Number	Interim Change No.	Effective Date	Description of Change
0		07/24/90	Initial issue
1		08/04/93	Complete revision in Sections I and 2: added Starter Tunnel items; deleted Exploratory Shaft Facility and replaced with Exploratory Studies Facility Optional Access.
2	1	11/23/93	Revised text and Table of Contents to show Section 2; added new Appendix A (Rationale for Natural Barriers on the Q-List); added List of Figures (page vii); added items to Appendices B, C and D. Alluvium has been removed from Q-List and placed on the Management Control List.
3		12/06/94	Revised to add items to the Q-List identified on Analysis/Evaluation Package Cover Sheets AT94-041 and AT-94-048 and added Q to the List and placed on the Management Control List.

Revision Number	Interim Change No.	Effective Date	Description of Change
4		02/17/97	Revised Introduction to reflect new procedure, YAP-2.7Q. Additions and deletions made to Q-List based on new classification analyses. Moved Non-Q items from Management Control List, YMP/93-17Q, to new Appendix B.
5		03/25/98	Complete revision of engineered items and engineered barriers sections to reflect May 1997 Mined Geologic Disposal System architecture.
6		05/10/2000	Complete revision of engineered items and engineered barriers section to reflect May 1999 Monitored Geologic Repository architecture. Revision incorporates results of the Quality Assurance classification process of QAP-2-3, Rev. 10 which references the system descriptions provided by Monitored Geologic Repository System Description Documents.
7		04/10/2001	Added acronyms to acronym list. Revised Section 1 to describe classification changes. Updated references in Section 7. Revised Attachment 1 to update revision status and reference citation for classification analyses that were revised/ created, and deleted two classification analyses that were canceled. Revised Attachment II for classifications of the Carrier Preparation Building Materials Handling System, Carrier/Cask Handling System, Waste Handling Building Ventilation System, Waste Emplacement System, and Waste Package Remediation System; added classification for Emplacement Drift System; and deleted classifications for Waste Retrieval System and Ex-Container System. For classifications in Attachment IV, deleted WBS designation and deleted Lateral Extent paragraph from description. Deleted Figure IV-1 and its sources (information is available in a cited reference). Minor editorial changes throughout document that do not affect technical content. During final production of Revision 6, the intended page II-2 of Attachment II was not included, resulting in 5 system classifications not being included. This revision corrects that error and includes all existing MGR Engineered Item SSCs.

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TABLES

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ACRONYMS AND ABBREVIATIONS

DOE	U.S. Department of Energy
ESF	Exploratory Studies Facility
ITS	important to safety
ITWI	important to waste isolation
Non-SC	Non-Safety Category
SC	Safety Category
SSCs	structures, systems, and components
YMP	Yucca Mountain Project

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1. INTRODUCTION

The purpose of this report is to document the safety classification of the Yucca Mountain structures, systems and components (SSCs) and to document the identification of engineered and natural barriers important to waste isolation. This report will support the conceptual and preliminary design activities for the Yucca Mountain Project (YMP).

Revision 1 of AP-2.22Q changed the issuing organization of the *Q-List* to Bechtel SAIC Company; therefore, the document identification number for this revision of the *Q-List* also changed. The change history contained in the front matter of this document describes the changes applicable to the previous document identifier (i.e., YMP-90-55Q).

This report provides the list of SSCs and barriers as one list rather than separate appendices for natural barriers and SSCs. Also, the Exploratory Studies Facility (ESF) SSCs have been incorporated into the repository systems and a separate appendix for ESF engineered items was deleted. Safety classifications documented by this report are provided in Appendix A.

As determined from Section 2.2.2 of *Quality Assurance Requirements and Description* (DOE 2003), this report is subject to the quality assurance program requirements for classifying items important to radiological safety and waste isolation. This report is developed in accordance with AP-2.22Q, *Classification Analyses and Maintenance of the Q-List*, and AP-3.11Q, *Technical Reports*.

2. CLASSIFICATION METHODOLOGY

2.1 METHOD

The process for classifying SSCs is provided by procedure AP-2.22Q. The process consists of establishing the configuration and function of SSCs and the effect of the SSCs on radiological safety. This information is then evaluated against criteria provided in AP-2.22Q to determine the safety classification of the particular item or feature.

The classification analysis method is based on an iterative design-classification process where each analysis iteration is considered a product for that phase of design. In this case, the system design and a best-estimate event sequence analysis are evaluated to identify the SSCs for which the quality assurance program requires design control. The results presented in this document, therefore, will be reevaluated and revised as necessary using a methodology appropriate to the level of event sequence analysis and system design detail. This approach is consistent with NUREG-1318 (Duncan et al. 1988, Section 4.2(a)), which allows engineering judgement and conservative bounding assumptions to be used in cases where data are limited.

Important to safety (ITS) and important to waste isolation (ITWI) are defined in 10 CFR 63.2 as:

> *Important to Safety*, with reference to structures, systems, and components, means those engineered features of the geologic repository operations area whose function is: 1) to provide reasonable assurance that high-level waste can be received, handled, packaged, stored, emplaced, and retrieved without exceeding the requirements of 10 CFR 63.111(b)(1) for Category 1 event sequences; or 2) to

> prevent or mitigate Category 2 event sequences that could result in radiological exposures exceeding the values specified at 10 CFR 63.111(b)(2) to any individual located on or beyond any point on the boundary of the site.

and

> *Important to Waste Isolation,* with reference to design of the engineered barrier system and characterization of natural barriers, means those engineered and natural barriers whose function is to provide a reasonable expectation that high-level waste can be disposed of without exceeding the requirements of 10 CFR 63.113(b) and (c).

The SSCs that are required to meet the performance objectives of 10 CFR 63.111(b)(1) for Category 1 event sequences or prevent or mitigate Category 2 event sequences that could result in radiological exposures that exceed the values specified in 10 CFR 63.111(b)(2) for offsite individuals are identified and classified in this report as Safety Category (SC). The SSCs that are ITS are identified in event sequence categorization analyses and event sequence dose consequence analysis documents.

Natural or engineered barriers that are important to meeting the performance objectives in 10 CFR 63.113 are identified (and classified) in this report as SC. The natural or engineered barriers that are ITWI are identified in a risk assessment that quantitatively estimates how the YMP system will perform in the future under the influence of specific features, events, and processes, incorporating uncertainty in the models and data. The assessment identifies natural and engineered barriers that are ITWI. Natural barriers are discussed in Section 3.3. Engineered barriers are included in the systems and subsystems included in Table A-2.

The safety category screening criteria used to identify SSCs as ITS or ITWI are presented in Section 4.

The safety classifications of the repository structures are summarized in Table A-1 of Appendix A. The safety classifications of the repository systems and subsystems are summarized in Table A-2 of Appendix A. Natural and engineered barriers that are determined to be important to waste isolation are also included in Table A-2 of Appendix A. The information summarized in Appendix A is identified in the *Safety Classification of SSCs and Barriers* (BSC 2003a, Attachment II). The natural and engineered barriers that are identified as important to waste isolation in that classification analysis are shown in the *Total System Performance Assessment for Site Recommendation* (CRWMS M&O 2000, Table 6.3-1).

2.2 DESIGN CONFIGURATION AND ARCHITECTURE

The system design configuration and the operations used for this report are based on "Transmittal of Preliminary Information-Design Input for Hazards Analyses" (Pedersen 2003, Enclosure 1). The system and subsystem architecture is identified in *Repository Design Requirements Allocation Matrix Document* (Doraswamy 2003).

2.3 EVENT SEQUENCE ANALYSIS

Preliminary Categorization of Event Sequences for License Application (BSC 2003b, Section 7) establishes the categorization (as Category 1 or Category 2) of the internal and external event sequences that may occur before permanent closure of the repository at Yucca Mountain. *Preliminary Consequence Analysis for License Application* (BSC 2003c) documents the calculated worker and offsite radiological doses. The dose calculation addresses both the normal operating dose consequences and the Category 1 and 2 event sequences dose consequences at the site boundary.

2.4 CLASSIFICATION OF SSCs

The SSCs were evaluated against the safety category screening criteria of AP-2.22Q to determine the safety category. The results of the dose consequence calculation (BSC 2003c) and the design information contained in "Transmittal of Preliminary Information-Design Input for Hazards Analyses" (Pedersen 2003, Enclosure 1) were used to determine the preliminary classification in this report. These classifications were performed in *Safety Classification of SSCs and Barriers* (BSC 2003a, Attachment II).

3. ITEMS IMPORTANT TO SAFETY AND WASTE ISOLATION

3.1 STRUCTURES, SYSTEMS, AND COMPONENTS

The SSCs listed in Appendix A are identified from the *Repository Design Requirements Allocation Matrix Document* (Doraswamy 2003).

3.2 ESF ENGINEERED ITEMS

The ESF engineered items previously classified in the *Q-List* (YMP 2001, Appendix D) are fully integrated into the repository architecture and are included in Appendix A. Table 1 shows the ESF engineered item and the identification of the same item in the repository architecture.

Table 1. ESF Engineered Item Comparison with Repository Architecture

ESF Engineered Item Classification (YMP 2001, Appendix D)	Repository Architecture Equivalent (Doraswamy 2003)
Subsurface Facility Operations System Main Access Openings	Underground Development, Non-Emplacement Drift Openings
Starter Tunnel	Underground Development, Non-Emplacement Drift Openings
Subsurface Facility Underground Support Areas South Portal Headwall	Underground Development, Non-Emplacement Drift Openings
Operations Support Area	Underground Development, Non-Emplacement Drift Openings
Test Support Area	Underground Development, Non-Emplacement Drift Openings
Ground Control System Main Access Openings	Underground Development, Ground Control for Non-Emplacement Drift Openings
South Portal Headwall	Underground Development, Ground Control for Non-Emplacement Drift Openings
Starter Tunnel	Underground Development, Ground Control for Non-Emplacement Drift Openings
Operations Support Areas	Underground Development, Ground Control for Non-Emplacement Drift Openings
Test Support Areas	Underground Development, Ground Control for Non-Emplacement Drift Openings
Transition Zones	Underground Development, Ground Control for Non-Emplacement Drift Openings

3.3 NATURAL BARRIERS

The natural barriers previously classified in the *Q-List* have been redefined and are included in Appendix A. Table 2 shows the natural barriers as defined by the previous revision of the *Q-List* (YMP 2001, Appendix B) and the YMP Classification Equivalent.

Table 2. Previous Natural Barrier Comparison with Revised Natural Barrier Nomenclature

Natural Barriers Important to Waste Isolation (YMP 2001, Appendix B)	YMP Classification Equivalent (CRWMS M&O 2000, Table 6.3-1)
Tiva Canyon Welded Hydrogeologic Unit	Surface Topography, Soils, and Bedrock
Paintbrush Nonwelded Hydrogeologic Unit	Unsaturated Zone Above the Repository
Topopah Spring Welded Hydrogeologic Unit	Unsaturated Zone Above the Repository
Calico Hills Nonwelded Hydrogeologic Unit	Unsaturated Zone Below the Repository
Saturated Zone	Saturated Zone (between the repository and the accessible environment)
Unconsolidated Surficial Materials and Other Geologic Units Not Identified on the *Q-List*	Surface Topography, Soils, and Bedrock

4. SAFETY CLASSIFICATION CRITERIA

The following safety category screening criteria used in the classification of repository SSCs is reproduced from procedure AP-2.22Q.

Safety Category (SC)—SSCs that are credited for prevention or mitigation in Category 1 and Category 2 event sequences so they meet the performance objectives in 10 CFR 63.111.

Natural or engineered barriers that are important to meeting the performance objectives in 10 CFR 63.113.

Non-Safety Category (Non-SC)—SSCs and natural/engineered barriers not credited for compliance to the performance objectives in 10 CFR 63.111 or and natural/engineered barriers that are not important to meeting the performance objectives in 10 CFR 63.113.

5. RESULTS

The safety classifications of SSCs and natural/engineered barriers are presented in Appendix A. Table A-1 lists the classifications of the repository structures and Table A-2 presents the classifications of the repository systems, subsystems, and natural/ engineered barriers (BSC 2003a, Attachment II).

As the design of the repository proceeds and further event sequence analyses of repository hazards are performed, the supporting classification analyses for this report will be revised and this report revised, as necessary.

6. REFERENCES

6.1 DOCUMENTS CITED

BSC (Bechtel SAIC Company, LLC) 2003a. *Safety Classification of SSCs and Barriers*. CAL-MGR-RL-000001 Rev. 00A. Las Vegas, Nevada: Bechtel SAIC Company, LLC. ACC: DOC.20030929.0014.

BSC 2003b. *Preliminary Categorization of Event Sequences for License Application.* CAL-MGR-RL-000002 REV 00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20030929.0010.

BSC 2003c. *Preliminary Consequence Analysis for License Application.* CAL-WHS-RL-000002 REV 00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20030929.0015.

CRWMS M&O 2000. *Total System Performance Assessment for the Site Recommendation*. TDR-WIS-PA-000001 REV 00 ICN 01. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20001220.0045.

DOE (U.S. Department of Energy) 2003. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 13. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20030422.0003.

Doraswamy, N. 2003. *Repository Design Project Requirements Allocation Matrix Document.* TDR-MGR-MD-000016 REV 00. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20030723.0003.

Duncan, A.B.; Bilhorn, S.G.; and Kennedy, J.E. 1988. *Technical Position on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements*. NUREG-1318. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 200650.

Pedersen, G.D. 2003. "Transmittal of Preliminary Information – Design Input for Hazards Analyses." Interoffice memorandum from G.D. Pedersen (BSC) to S.J. Cereghino, July 1, 2003, 0701037916, with enclosures. ACC: MOL.20030702.0115.

YMP (Yucca Mountain Site Characterization Project) 2001. *Q-List.* YMP/90-55Q, Rev. 7. Las Vegas, Nevada: Yucca Mountain Site Characterization Office. ACC: MOL.20010409.0366.

6.2 STANDARDS, CODES, AND REGULATIONS

10 CFR 63. Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. Readily available.

6.3 PROCEDURES

AP-2.22Q, Rev. 1, ICN 0. *Classification Analyses and Maintenance of the Q-List*. ACC: DOC.20030807.0002.

AP-3.11Q, Rev. 4, ICN 0. *Technical Reports.* Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: DOC.20030827.0015.

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APPENDIX A

Q-LIST

Table A-1. Classification of Structures

Structure	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Balance of Plant (Consists of: Administration Building Emergency Operations Center Utility Building Fire Station/ Medical Center Central Warehouse/ Central Shops Visitors Center Motor Pool and Service Station Security Station)	No	No	Non-SC
Cask Receipt and Return [Includes Intermodal Transfer, Cask Preparation, and Cask Buffer Areas]	Yes	No	SC
Dry Transfer Facility	Yes	No	SC
Heavy Equipment Maintenance Warehouse and Non-Nuclear Receipt Building	No	No	Non-SC
Remediation Building	Yes	No	SC
Subsurface	No	Yes	SC

Source: BSC 2003a, Attachment II

Table A-2. Classification of Systems and Subsystems

System	Subsystem or Function	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Cask Preparation	Cask Handling	Yes	No	SC
	Gas Sampling	No	No	Non-SC
	Cask Decontamination	No	No	Non-SC
	Trolley	Yes	No	SC
Cask Receipt and Return	Cask Receipt	Yes	No	SC
	Cask Preparation	Yes	No	SC
	Cask Buffer [Staging]	Yes	No	SC
Commercial and Naval Spent Nuclear Fuel Cladding	Engineered Barrier	No	Yes	SC
Communications	Telephone–Wireless Voice	No	No	Non-SC
	Data	No	No	Non-SC
	Video	No	No	Non-SC
	Public Address	No	No	Non-SC
Digital Control and Management Information	Digital Control	No	No	Non-SC
	Management Information	No	No	Non-SC
DOE and Commercial Waste Package	Engineered Barrier	Yes	Yes	SC
DOE Spent Nuclear Fuel Disposable Canister	DOE Spent Nuclear Fuel Disposable Canister	Yes	No	SC
Electrical Power	Emergency Diesel Generator System	No	No	Non-SC
	Emergency DC Power System	No	No	Non-SC
	Emergency UPS Power System	No	No	Non-SC
	Normal AC Electrical Power	No	No	Non-SC
	Normal DC Electrical Power	No	No	Non-SC
	Normal UPS Power	No	No	Non-SC
	Site Electrical Distribution	No	No	Non-SC
	Solar Power	No	No	Non-SC
	Standby Diesel Generator	No	No	Non-SC

Table A-2. Classification of Systems and Subsystems (Continued)

System	Subsystem or Function	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Electrical Support	Lighting	No	No	Non-SC
	Lightning Protection	No	No	Non-SC
	Grounding	No	No	Non-SC
	Cathodic Protection	No	No	Non-SC
	Heat Trace	No	No	Non-SC
	Cable Raceway	No	No	Non-SC
Emplacement Drift	Emplacement Drifts Excavation	No	No	Non-SC
	Ground Control for Emplacement Drifts	No	No	Non-SC
	Drift Invert	No	Yes	SC
	Waste Package Emplacement Pallet	No	No	Non-SC
Emplacement and Retrieval	Waste Package Loadout Preparation	Yes	No	SC
	Waste Package Transportation	Yes	No	SC
	Waste Package Emplacement	Yes	No	SC
	Waste Retrieval	Yes	No	SC
Environmental– Meteorological Monitoring	Meteorological Monitoring	No	No	Non-SC
	Seismic Monitoring	No	No	Non-SC
Fire Protection	Fire Water	No	No	Non-SC
	Fire Barriers	No	No	Non-SC
	Explosion Protection	No	No	Non-SC
	Fire Suppression	No	No	Non-SC
	Fire Detection	No	No	Non-SC
	Fire Alarm	No	No	Non-SC
Heating, Ventilation, and Air-Conditioning (HVAC) Plant Heating and Cooling	HVAC Heating	No	No	Non-SC
	HVAC Cooling	No	No	Non-SC
Naval Spent Nuclear Fuel Waste Package	Engineered Barrier	Yes	Yes	SC
Non-Nuclear Handling	Receipt	No	No	Non-SC
	Warehouse	No	No	Non-SC
	Waste Package–Site-Specific Cask Preparation	No	No	Non-SC

Table A-2. Classification of Systems and Subsystems (Continued)

System	Subsystem or Function	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Non-Radioactive Waste Management	Hazardous Waste	No	No	Non-SC
	Nonhazardous Waste	No	No	Non-SC
Performance Confirmation	Performance Confirmation Data Acquisition/ Monitoring	No	No	Non-SC
	Performance Confirmation Emplacement Drift Monitoring	No	No	Non-SC
	Performance Confirmation Waste Isolation Verification–Validation	No	No	Non-SC
Plant Services	Air	No	No	Non-SC
	Service Gases	No	No	Non-SC
	Fuel Oils	No	No	Non-SC
	Water	No	No	Non-SC
Post-Emplacement	Inspection and Maintenance	No	No	Non-SC
	Operational Monitoring	No	No	Non-SC
	Final As-Built Surveys	No	No	Non-SC
	Decommissioning and Decontamination	No	No	Non-SC
	Closure [and Seals]	No	No	Non-SC
	Postclosure Monitoring	No	No	Non-SC
	Drip Shield	No	Yes	SC
Radiation and Radiological Monitoring	Radiation and Radiological Monitoring	No	No	Non-SC
Remediation	Dry Spent Nuclear Fuel/High-Level Radioactive Waste Transfer	Yes	No	SC
	Wet Spent Nuclear Fuel Transfer (pool)	Yes	No	SC
	Decontamination	No	No	Non-SC
	Cask Preparation	Yes	No	SC

Table A-2. Classification of Systems and Subsystems (Continued)

System	Subsystem or Function	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Safeguards & Security	Access Controls	No	No	Non-SC
	Surveillance	No	No	Non-SC
	Intrusion Detection and Assessment	No	No	Non-SC
	Physical Barriers	No	No	Non-SC
	Testing and Maintenance	No	No	Non-SC
	Response	No	No	Non-SC
	Material Control and Accountability of Spent Nuclear Fuel/High-Level Radioactive Waste	No	No	Non-SC
	Security Communication	No	No	Non-SC
Saturated Zone (between the repository and the accessible environment)	Natural Barrier	No	Yes	SC
Site-Generated Radioactive Waste Management	Fuel Pool Cooling and Cleanup	No	No	Non-SC
	Liquid Waste	No	No	Non-SC
	Solid Waste	No	No	Non-SC
	Gaseous Waste	No	No	Non-SC
	Mixed Waste	No	No	Non-SC
	Spent Dual-Purpose Canisters	No	No	Non-SC
Spent Nuclear Fuel Aging	Cask Transportation	Yes	No	SC
	Aging Pad	Yes	No	SC
	Aging Cask/Site-Specific Cask	Yes	No	SC
Spent Nuclear Fuel/High-Level Radioactive Waste Transfer	Confinement	No	No	Non-SC
	Dual-Purpose Canister Cutting	Yes	No	SC
	Assembly Transfer	Yes	No	SC
	Canister Transfer	Yes	No	SC
	Spent Nuclear Fuel/High-Level Radioactive Waste Staging	Yes	No	SC
Spent Nuclear Fuel/High-Level Radioactive Waste Transfer (continued)	Spent Nuclear Fuel/High-Level Radioactive Waste Transfer Control	No	No	Non-SC

Table A-2. Classification of Systems and Subsystems (Continued)

System	Subsystem or Function	Important to Safety (ITS)	Important to Waste Isolation (ITWI)	Safety Category (SC)
Subsurface Development	Non-Emplacement Drift Openings	No	No	Non-SC
	Ground Control for Non-Emplacement Drift Openings	No	No	Non-SC
	Excavation	No	No	Non-SC
Subsurface Ventilation	Emplacement Ventilation	No	No	Non-SC
	Development Ventilation	No	No	Non-SC
Surface Topography, Soils and Bedrock	Natural Barrier	No	Yes	SC
Surface Industrial HVAC	Surface Industrial HVAC	No	No	Non-SC
Surface Nuclear HVAC	Surface Nuclear HVAC	No	No	Non-SC
Transportation Cask	Transportation Cask	Yes	No	SC
Unsaturated Zone above the Repository	Natural Barrier	No	Yes	SC
Unsaturated Zone below the Repository	Natural Barrier	No	Yes	SC
Waste Form	Engineered Barrier	No	Yes	SC
Waste Package Closure	Welding	No	No	Non-SC
	Inerting	No	No	Non-SC
	Non-Destructive Testing	No	No	Non-SC
	Stress Mitigation	No	No	Non-SC

Source: BSC 2003a, Attachment II